# *Patterns of Posttraumatic Stress Symptoms, Substance Abuse, and Depression Among Deploying U.S. Marines*

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# Patterns of Posttraumatic Stress Symptoms, Substance Abuse, and Depression Among Deploying U.S. Marines

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## Abstract

This study explored adjustment among combat veterans in relation to the deployment cycle. In particular, it evaluated potential linear and nonlinear patterns in symptom levels in relation to both time since return home and time prior to future departure, and assessed the homogeneity of patterns of change over time across different outcomes. Personnel from U.S. Marine Corps units at three installations in Southern California completed an anonymous survey assessing a range of mental, behavioral, and physical health outcomes. Participants also were asked about their place within the deployment cycle. Results yielded scant evidence for nonlinear patterns of symptom development following deployment. However, 3 potentially at-risk populations identified included (1) personnel with a short deployment interim, particularly in relation to substance abuse; (2) combat veterans who are not redeploying, among whom future studies might be able to more specifically identify persons at risk of comorbid disorders such as those trying to avoid redeploying or those processing out because of mental or physical health problems; and (3) combat veterans imminently preparing to redeploy, among whom symptoms of stress may be as high or higher than those who have recently returned.

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## Summary

**Background:** During times of war or disaster, posttraumatic stress disorder (PTSD) prevalence rates have become a scientifically accepted gauge of the emotional impact of trauma, and they are often used to justify public concern and support for victims (J. Breslau, 2004). However, PTSD symptoms are just one part of a wide spectrum of possible reactions to trauma. Moreover, PTSD is more likely to co-occur with other types of mental health problems than to occur as an isolated problem (Kilpatrick et al., 2003). The high comorbidity of PTSD with other types of disorders suggests that a number of different mental health problems may have interrelated developmental pathways. Within the armed forces, and in the current context of frequent rotating deployments, understanding the chronological development of PTSD and comorbid disorders such as depression and substance use is crucial to determining individual readiness to redeploy. An understanding of comorbid developmental trajectories could also help to address the question of whether there are specific policies that might reduce the risk of poor long-term outcomes among deploying personnel, and whether there are critical time frames across the deployment cycle when these policies should optimally be brought to bear.

**Objective:** The purpose of this study was to map comorbid symptom patterns of posttraumatic stress, depression, and substance use across time with respect to the deployment cycle. The goal was to assess whether different types of symptoms would show similar trajectories and to determine periods of peak symptomology within a context of rotating combat deployments.

**Methods:** This was a secondary analysis of data from the Naval Health Research Center study of Combat Stress and Substance Use in the U.S. Marine Corps. These data were collected using a self-report, cross-sectional survey, conducted between August 2006 and August 2007. Participants ($N$ = 1,860) were active-duty personnel representing air, support, and infantry units.

**Results:** Analyses produced mixed results regarding patterns of change in symptoms over time in relation to the deployment cycle. Notably, though, the impact of the passage of time on adjustment appeared more consistent for combat veterans approaching a future deployment than it did among those returning home following deployment. We found no evidence that peak symptoms of PTSD or any other outcome either preceded or followed one another in time. Also, we had expected that following deployment symptoms might rise initially and peak 4–6 months. We were not able to verify any evidence of this nonlinear pattern. However, future longitudinal research may be able to better assess these issues. The following list summarizes additional key findings in this report.

1. There were significant differences across groups of personnel in different circumstances with respect to the deployment cycle for all mental health, substance use, and physical health outcomes considered in this report. Those preparing for their first deployment and those who had not and would not deploy reported tended to have lower symptom levels than did combat veterans (pp. 21, 31, 32, 33, 35, 55).
2. Participants with a short deployment cycle and those who had deployed but did not expect to deploy again generally reported the highest symptom levels (p. 21). A short deployment cycle appeared to be most strongly related to increases in substance use, specifically heavy drinking (pp. 26, 27, 30, 35, 55).
3. Correlations between the intensity of PTSD symptoms and other types of outcomes were consistently stronger for combat veterans than for nonveterans (p. 21).
4. Of all the outcomes considered, depression was most strongly correlated with PTSD (pp. 21, 53). However, PTSD and depression were differentially related to deployment factors such as combat exposure and deployment cycle patterns (pp. 26, 33, 38).

5. Substance use, including heavy drinking, illegal drug use, and tobacco use were more weakly related to PTSD symptom levels than were other outcomes, particularly depression and physical pain level (pp. 21, 53).
6. Although symptom levels tended to decrease over time following deployment (p. 23), this pattern was only reliably significant for heavy drinking (pp. 29, 28, 36).
7. Symptom levels tended to increase over time with the approach of a pending future deployment (p. 23, 31, 32, 37). Furthermore, the effect of time until departure on symptom levels was larger and more consistent than was the effect of time since last deployment (pp. 34, 37).
8. Results for substance use variables suggest complex patterns of influence; potential contributing factors may include military policy, social norms, and operational stress levels (pp. 25, 31, 33, 38, 39, 55).

**Conclusions:** Potentially at-risk populations among combat veterans include personnel with a short deployment interim, who could be particularly targeted with substance abuse prevention efforts. Another target group may be combat veterans who are not redeploying. Among these personnel, future studies might be able to more specifically identify persons at risk of comorbid disorders such as those who choose to leave the service or change occupational specialty in order to avoid redeploying or those who process out because of their mental or physical health status. Finally, more attention could be focused on the stress experienced by combat veterans imminently preparing to redeploy. Mental health symptomology may be as high or higher among this group than among those who have recently returned home.

# Introduction

Existing research on the effects of military deployment suggests that combat trauma is a risk factor for mental health problems, particularly posttraumatic stress disorder (Boscarino, 1995; Hoge et al., 2004). As a diagnosis, PTSD has played a unique role in public perceptions of the impact of war and world disaster. In a conceptual review, Breslau (2004) suggested that PTSD prevalence has become a scientifically accepted gauge of the emotional impact of trauma, and it is often used to justify public concern and support for victims. However, PTSD symptoms are just one part of a wide spectrum of possible reactions to trauma. Moreover, PTSD is more likely to co-occur with other types of mental health problems than to occur as an isolated problem (Kilpatrick et al., 2003). For example, high rates of alcohol abuse, smoking, and illegal drug use have been associated with PTSD (Barrett et al., 2002; Boman, 1986; Branchey, Davis, & Lieber, 1985; Federman, Bray, & Kroutil, 2000; Green, Grace, Lindy, Gleser, & Leonard, 1990; Grieger, Fullerton, Ursano, & Reeves, 2003; Hoge et al., 2004; Keane, Gerardi, Lyons, & Wolfe, 1988; Stewart, 1996). In addition, depression and PTSD are frequently comorbid (Basoglu, Kilic, Salcioglu, & Livanou, 2004; N. Breslau, 2002; N. Breslau, Davis, Peterson, & Schultz, 1997), with some inherent overlap between the symptomologies of PTSD and depression (Ferrada-Noli, Asberg, & Ormstad, 1998).

The purpose of the present study was to describe patterns across time in comorbid symptoms of posttraumatic stress, depression, and substance use with respect to the deployment cycle. The goal was to assess whether different types of symptoms exhibit similar trajectories and to determine periods of peak symptomology in a context of rotating deployments. Understanding interwoven patterns of symptom levels among disparate mental health outcomes such as PTSD, depression, and substance use is likely to have important practical implications.

For example, it may help military clinicians to effectively target interventions at the individuals who are most vulnerable, at the time when they are at greatest risk, thereby making the most effective use of scarce resources. In addition, given that current operational conditions often require personnel to deploy multiple times, understanding time-related patterns in symptoms of PTSD, depression, and substance use could be crucial in evaluating individual readiness to redeploy. This type of information could be used to craft better policies and to determine specific time frames across the deployment cycle when these policies should optimally be brought to bear.

Recently, a number of research studies have sought to elucidate typical patterns in the development of PTSD symptomology following return from deployment. Among veterans returning from Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) there has been evidence of delayed symptom development (Bliese, Wright, Adler, Thomas, & Hoge, 2007; Grieger et al., 2006; Hoge, Auchterlonie, & Milliken, 2006), with adjustment difficulties peaking from 4–6 months postdeployment. Bliese et al. (2007) speculated that this finding may either indicate actual delayed symptom development or a reluctance to report symptoms during an initial homecoming "honeymoon" phase. Combat veterans' reluctance to report mental health problems initially may be fueled by concerns that such symptoms are socially unacceptable and that divulging them might have negative short- and long-term consequences.

Some seminal work on adjustment among veterans following deployment to OIF and OEF has made use of data from official military personnel surveys (Bliese et al., 2007; Hoge et al., 2006). This may increase the likelihood of socially desirable responding, making it harder to distinguish between initial underreporting and actual delayed onset of symptoms. Furthermore, most longitudinal studies can only assess participants at a very limited number of pre-specified

time points (Bliese et al., 2007). Anonymous or confidential surveys of combat veterans at time points across the full spectrum of the deployment cycle could provide a broader perspective on patterns of adjustment following deployment. In particular, such surveys might help to answer questions regarding the timing of peak symptomology. For example, do postdeployment symptoms levels follow a nonlinear pattern increasing initially, peaking at 4–6 months and decreasing thereafter? Alternatively, does adjustment follow a more simple linear pattern, with symptoms decreasing over time?

Another potentially important factor that has not often been considered in research on operational stress and the deployment cycle is the build-up required to prepare for deployment. Most research has focused on adjustment over time following return. However, a study by Killgore, Stetz, Castro, and Hoge (2006) considered the possibility that personnel within 2 weeks of deploying might be experiencing symptoms of stress and that those experiences could be modified by prior combat exposure. On a set of scales assessing somatic versus affective symptoms, these researchers found that veterans reported more somatic symptoms than affective symptoms, and more somatic symptoms in comparison with first-time deployers. First-time deployers reported both types of symptoms levels equivalently. Although this is an isolated finding, it indicates that the approach of a future deployment is a time when personnel may have difficultly managing symptoms of stress. Furthermore, a prior history of combat deployment may moderate reactions to redeployment. Research studies should consider the relative timing of both past and future deployments and the potential moderating effects of deployment history on adjustment.

*Current Study*

The results of previous research suggest some specific questions regarding mental health outcomes for military personnel in relation to the deployment cycle. First, do overall symptom levels of PTSD, depression, and substance abuse rise and fall in parallel over the course of the deployment cycle, or might particular types of symptoms peak at different points? Second, does the use of substances follow a decreasing linear pattern after return from deployment or do it show an inverted U-shaped function, peaking between 4 and 6 months postdeployment and subsiding thereafter? Third, what is the impact of anticipated future deployment on mental health symptoms? That is, might mental health symptoms begin to increase again as a future deployment approaches? Finally, how might combat veterans and nonveterans differ in reporting changes in physical and behavioral versus psychological symptoms in relation to the increased operational stress of preparing for deployment? In other words, does a prior history of combat deployment moderate the strength of relationships between the stress of deployment cycle timing and different adjustment outcomes?

*Hypotheses*

1. Among returning combat veterans, patterns of high versus low symptomology for PTSD, depression, and substance abuse will follow parallel courses across time.
2. Among combat veterans returning from deployment, peak symptomology for PTSD, depression, and substance use will occur 4–6 months after return. Thus, the pattern of symptoms over time will be an inverted U-shaped function, increasing initially and subsequently subsiding.

3. As a future combat deployment approaches, both veterans and nonveterans will demonstrate linear increases in mental and physical health symptoms.
4. When anticipating an upcoming deployment, combat veterans will report a greater increase in physical or behavioral symptoms (e.g., pain levels, excessive substance use) than first-time deployers, and less of an increase in affective symptoms.

## Methods

This study used data from the Naval Health Research Center (NHRC) Combat Stress and Substance Use (CSSU) survey of U.S. Marine Corps personnel. This self-report, cross-sectional survey was sponsored by Headquarters, Marine Corps Office of Prevention and Intervention to document substance use among Marines across the deployment cycle and to identify risk factors for substance abuse among combat veterans. The CSSU was conducted between August 2006 and August 2007.

### *Participants*

Participants were active-duty personnel at Marine Corps Air Station Yuma, Arizona (32%; primarily 3rd Marine Aircraft Wing, 23%), 1st Marine Logistics Group at Marine Corps Base (MCB) Camp Pendleton (36%), and 1st Marine Division at MCB Camp Pendleton and MCB Twentynine, California (32%). These commands represent air, support, and infantry units. A total of 2,612 personnel (representing 23% of the population of participating units) attended a session. Of these, 2,539 participants completed some part of the survey, yielding a 97% participation rate. However, some participants (348; 14%) did not provide critical deployment history and outcome information for this study (history of any combat deployment and length of time since return, PTSD, depression, illegal drug use, alcohol problems, tobacco use, and current

pain level/sources), and were not included in any analyses for this report. Additional respondents failed to provide information regarding the likelihood and timeline of future deployment (331; 13%), and could not be included in analyses involving personnel preparing for departure.

We compared the demographic characteristics of persons excluded due to missing data (679) with those in the study sample ($N$ = 1,860). Not surprisingly, missing data were more common among those with younger age, lower rank, and less education ($p < .001$). However, there were no significant differences based on sex or service. Furthermore, there were few overall mean differences among our primary outcome variables. Those with missing data were somewhat more likely to report symptoms of PTSD ($M$ = 0.95, $SD$ = 0.93 vs. $M$ = 0.84, $SD$ = 0.84, $p < .01$) and to use illegal drugs (6% vs. 3%, $p < .01$). When the magnitude of bivariate correlations among the nine outcome variables were compared for those excluded due to missing data versus those in the study sample, only 2 of 36 comparisons were statistically significant ($p < .05$); both heavy drinking and total physical health problems were more weakly related to the API alcohol dependence scale for those with missing than for complete data (for heavy drinking, $r$s = .47 and .54, respectively; for health problems, $r$s = .26 and .36, respectively).

Most participants included in this study were young (53% aged 22 years or younger), and junior ranking (70% at rank E4 or below). Only 4% were commissioned officers. They were also primarily male, including only 8% female personnel. About half had a high school diploma or less (53%). Although only Marine Corps units were surveyed, 7% of participants were U.S. Navy personnel serving with Marine Corps units.

Because a primary focus of the present research was the deployment cycle, we attempted to classify respondents into groups that were somewhat homogeneous with respect to deployment timing. Four groups were created: (1) personnel who had not deployed and did not

expect to deploy in the future (never; $n$ = 140); (2) personnel who had deployed in the past but did not expect to deploy again (not again, $n$ = 269); (3) personnel who had not yet deployed but expected to deploy in the future (not before, $n$ = 639); and (4) personnel who had previously deployed and expected to redeploy again (in-between, $n$ = 812). The latter group was further subdivided into two groups based on their length of time at home between deployments: (4a) personnel with less than a year between deployments (short cycle; $n$ = 235), and (4b) those with more than a year at home between deployments (long cycle, $n$ = 577). Table 1 lists the demographic characteristics of participants in each deployment cycle group. Because there were significant differences ($p < .001$) between deployment groups for all demographic variables except sex, all multivariate analyses controlled for demographic characteristics.

*Procedure*

Participants were recruited in groups ranging in size from 28 to 408. Potential volunteers were read an informed consent form explaining that their participation was voluntary and there would be no repercussions for nonparticipation. They were told that they did not have to answer any questions they did not want to answer and they could quit at any time. To better ensure that participation would be voluntary, officers and noncommissioned officers were recruited in separate sessions from junior enlisted personnel. Participants completed the survey anonymously, and then sealed their individual surveys in stamped envelopes addressed to Northern Illinois University. Those who chose not to participate were asked to sit quietly and then seal their blank surveys in their mailing envelopes as if they had participated.

Table 1

*Demographic Characteristics by Deployment Status*

| Demographic | Short Cycle | Long Cycle | Not Again | Not Before | Never |
|---|---|---|---|---|---|
| Sex (female) | 6% | 7% | 7% | 8% | 13% |
| Age, years | | | | | |
| 17–20 | 19% | 7% | 3% | 45% | 15% |
| 21–30 | 69% | 68% | 89% | 52% | 83% |
| ±31 | 11% | 25% | 8% | 3% | 2% |
| Service (Navy) | 3% | 13% | 6% | 5% | 6% |
| Rank | | | | | |
| E1–E4 | 70% | 45% | 72% | 90% | 82% |
| E5–E9 | 23% | 50% | 25% | 7% | 17% |
| Officers | 7% | 6% | 3% | 3% | 1% |
| Education | | | | | |
| <High school diploma | 3% | 4% | 4% | 3% | 4% |
| High school diploma | 50% | 42% | 49% | 58% | 45% |
| Some college/tech. | 47% | 54% | 47% | 39% | 51% |
| Sample *N* | 231–235 | 560–570 | 258–267 | 618–635 | 137–140 |

*Note.* Due to missing data on demographic variables, *n*s vary. Demographic comparisons were significant ($p < .001$) for all characteristics except sex.

*Primary Measures*

The CSSU asked for demographic information, including age, rank, occupational field, sex, education level, and family status (spouse/children). In addition, participants were asked a number of questions regarding their combat deployments, defined as any period of time during

which participants had received imminent danger pay or combat zone tax exclusion benefits. Specifically, participants were asked to provide the total number of times they had been deployed, the length of their last deployment, the number of months they had been home since their last deployment, and how long they expected it to be before they deployed again (0, *never*; 1, *within 3 months*; 2, *4–6 months*; 3, *7–9 months*; 4, *10–12 months*; 5, *over 1 year*).

*Combat Exposure*. The seventeen items assessing combat trauma were taken from several sources (Hoge et al., 2004; King, King, & Vogt, 2003; Maguen, Litz, Wang, & Cook, 2004). These items were modified in order to make the formatting homogenous. We also changed some wording to make the items more specific to the types of combat experiences Marine Corps personnel encounter in OIF and OEF. Respondents were asked to estimate the number of times they experienced specific types of events during any previous combat deployment. Response options were on a 5-point scale (0, *never;* ; 1, *1 to 3 times*; 2, *4 to 12 times*; 3, *13 to 50 times*; 4, *51 or more*) adopted from a measure by Kean et al. (1989). Responses were summed to form a Combat Exposure Scale with good internal consistency (Cronbach's alpha, .89).

*Posttraumatic Stress Symptoms.* The PCL (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) assessed current symptoms of PTSD. In prior research, the internal consistency of the PCL has been high, (alpha, .96–.97). In addition, the PCL has been widely used in research with varied populations, including veterans of the current Iraq and Afghanistan conflicts (Hoge et al., 2004; Rona et al., 2006). We chose to use the civilian version of PCL rather than the combat version, because this allowed us to assess PTSD for all personnel, regardless of whether they had been deployed. However, we did include an additional qualifying item asking participants to estimate the extent to which their re-experiencing and avoidance symptoms were related to combat experiences (1, *never*; 5, *all the time*).

The PCL consists of 17 items, each describing one of the criterion symptoms for PTSD as outlined in the *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* (American Psychiatric Association, 1994). Participants rated how much each symptom had been a problem for them in the past 30 days (0, *not at all*; 4, *extremely*). Item responses were averaged to create a total PTSD symptom score. In addition, separate indices were created to represent the PTSD symptom clusters of hyperarousal (5 items), re-experiencing (5 items), and avoidance and numbing (7 items). For the purposes of this study, we excluded 1 item in computing the avoidance and numbing scale, making it a 6-item scale and making the total scale a 16-item scale (PCL-16; Cronbach's alpha, .94). This was done to avoid overt overlap in assessed symptoms of PTSD and depression (see description of depression scale below).

*Depression.* One of the primary challenges in assessing the comorbidity of depression and PTSD is the issue of overlapping symptoms. The core characteristics of depression are captured by the brief Patient Health Questionnaire-2 (PHQ-2): (a) depressed mood, and (b) loss of interest/pleasure in activities (Hoge et al., 2006; Kroenke, Spitzer, & Williams, 2003; Whooley, Avins, Miranda, & Browner, 1997). Modified versions of the PHQ-2 items were included in the CSSU. The first asked respondents to rate how much they had experienced "feeling down, depressed, or hopeless" in the past 30 days. The second symptom, "loss of interest in activities that you used to enjoy," is assessed by the PCL as an aspect of PTSD. Because this symptom is a more primary symptom of depression than PTSD, we chose to exclude it in computing PCL scores and only use it as a symptom of depression. Responses to both of these questions were made on a 5-point scale (1, *not at all*; 5, *extremely*). Four other items were written for the CSSU assessing symptoms of depression (American Psychiatric Association, 1994) while avoiding overlapping symptoms of PTSD assessed by the PCL, such as

sleep disturbance and difficulty concentrating (Weathers et al., 1993). These items assessed problems with feelings of grief or loss, lack of energy, keeping one's mind off of problems, and lack of confidence. Responses were given on a 5-point scale (1, *extremely hard*; 5, *extremely easy*). Total scores on the DSS were computed by averaging responses across these four items and the two modified PHQ-2 items. The DSS had good internal consistency (Cronbach's alpha, .86).

*Current Substance Use*. Respondents rated how often they had used illegal drugs in the past 30 days, using a 6-point scale (0, *never*; 5, *4 or more times per week*). Because of the low expected frequency of actual illegal drug use expected from this population, using the same response scale, we also asked participants how often they felt tempted to use illegal drugs as an additional measure of risk. These two questions were significantly correlated (.42, $p < .001$) supporting convergent validity and predictive utility. They were also asked for the total number of cigarettes and dips/chews of smokeless tobacco they typically used per day during the past 30 days (Trent, Hilton, & Melcer, 2005). Heavy alcohol use was assessed using questions adapted from the NHRC Millennium Cohort Study (Chesbrough et al., 2002; Riddle et al., 2007; Ryan, 2007). In particular, to assess heavy episodic drinking, participants were asked how often they had 5 or more alcoholic drinks on one occasion during the past month (0, *never*; 1, *1–3 times a month*; 2, *once a week*; 3, *2–3 times a week*; 4, *±4 times a week*).

The survey included 5 additional items assessing alcohol dependence and behavioral problems associated with alcohol abuse within the past 30 days. Each item was assessed in yes/no format. The first 2 items were a modified version of the Two-Item Conjoint Screen (TICS) for alcohol and substance dependence. This measure is a brief, validated measure of both alcohol and drug dependence (TICS; Brown, Leonard, Saunders, & Papasouliotis, 2001). The

TICS items are (a) in the last year, have you ever drunk or used drugs more than you meant to? and (b) have you felt you wanted or needed to cut down on your drinking or drug use in the last year? Brown et al. (2001) found that a positive response to either of these 2 questions predicted substance use dependence with a sensitivity of 79% and a specificity of 78%. For the CSSU, we modified the TICS to ask specifically about alcohol. In addition to the TICS, participants were asked if during the past 30 days they had "felt guilt or remorse after drinking." Previous research has noted that using guilt and remorse following drinking as a single-item indicator of alcohol dependence has good sensitivity and specificity (83% and 84%, respectively; Cherpitel, 2000). The CSSU also asked about current behavioral problems associated with alcohol use: "I drove a car after having several drinks or after drinking too much" and "I missed or was late for work or other military duties because I was drinking or hung over." These items were adapted from the PHQ (Spitzer, Kroenke, & Williams, 1999). The API was computed as the total number of "yes" responses across these 5 items (Cronbach's alpha, .71; possible range, 0–5).

*Physical Pain*. Two indices reflected current problems with pain. The first was the overall level of physical pain experienced in the last 30 days (1, *none*; 5, *severe*). The second was the total number of sources of physical pain in the past 30 days, endorsed out of a set of 7 possibilities (combat injury, noncombat injury, stress or strain, disease/illness, hangover or withdrawal, other).

### *Data Analysis*

Analyses were conducted using PASW Statistics 17.0.3 (SPSS Inc., 2009). Missing data for demographic and control variables in multivariate analyses were replaced with the sample mean. Post hoc tests for analyses of variance (ANOVAs) were conducted using the Games-Howell procedure (Howell, 1992). Initial regression analyses were replicated using Amos 7.0.2

software (Arbuckle, 2006), using full-information maximum likelihood estimation to address missing data. Because results obtained using Amos did not differ substantively from those obtained using mean replacement, we chose to report only the more familiar standard regression analyses conducted using SPSS. Because the distributions of 2 of our primary deployment timing variables (months since return from last deployment and duration of last deployment) showed considerable skew and kurtosis, these variables were transformed using a square root transformation. In addition, to reduce multicollinearity, these deployment timing variables were standardized prior to computing higher order nonlinear terms and interactions. Finally, all dependent variables were standardized in order to directly contrast the predictive power of each independent variable (IV) across outcomes using a method described by J. Cohen, P. Cohen, West, and Aiken (2003; P. Cohen, Brook, Cohen, Velez, & Garcia, 1990).[1]

## Results

Table 2 presents means for our 9 outcomes (PCL-16, DSS, API, heavy drinking, temptation to use drugs, drug use, nicotine use, pain level, and pain sources) by deployment cycle group. A 1-way multivariate analysis of variance (MANCOVA) (controlling for sex, age,

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[1]Using this method, difference scores are computed between predicted values from the regression analysis for 1 outcome and scores on a second outcome. This difference score is then regressed on the full set of predictors. Significance tests of the regression coefficients from this second-order regression analysis test the null hypothesis that the predictor is equally related to the 2 outcomes. Direct comparisons such as these are important, because the fact that a particular IV is significant in relation to 1 outcome but not in relation to another does not necessarily indicate a statistically reliable difference in the effect of the IV across outcomes. Similarly, the fact that an IV is significantly related to 2 different outcomes does not address whether its effects are equally strong for both outcomes.

rank, service, and education) revealed a significant multivariate effect of deployment cycle group, Wilks' Lambda (36, 6904.56) = 5.31, $p < .001$. Follow-up univariate ANOVAs confirmed significant main effects for deployment cycle for each individual outcome ($p < .001$).

As seen in Table 2, personnel preparing for their first deployment had fewer symptoms (lower means) on every outcome than did veterans with a short deployment cycle or veterans never expecting to redeploy. Those preparing for their first deployment did not significantly differ from those who had not and would not deploy in any case. In contrast, participants with a short deployment cycle and those who had deployed but did not expect to deploy again generally reported the highest symptom levels; these 2 groups did not differ on any outcome. Participants with a long deployment cycle exhibited the fewest differences from other groups, with mean symptom levels generally in the mid-range of the 5 groups. However, personnel in the long cycle group still reported significantly poorer outcomes than did participants preparing for a first deployment in 6 out of 9 comparisons (PTSD, alcohol problems, binging, tobacco use, pain level, and pain sources). It should be noted that all group differences were fairly small. Group membership accounted for only 1% (illegal drug use) to 4% (PTSD) of the variance in symptom levels across outcomes.

The 9 outcome variables were significantly intercorrelated (see Appendix 2, Table A). Correlations were generally stronger for combat veterans than nonveterans, and significantly so in several instances. In particular, correlations with PTSD were stronger for combat veterans in the case of alcohol problems (API), heavy drinking, illegal drug use, tobacco use, and total sources of physical pain. None of these correlations were significantly stronger for nonveterans. There were also some differences in the relative strength of correlations with PTSD across outcomes. Effect sizes were greatest for depression, pain level, and pain sources, as well as

alcohol problems/addiction. Among veterans and nonveterans alike, these 4 variables had significantly stronger correlations with PTSD than did heavy drinking tobacco use, or illegal drug use; depression, in particular, had a significantly stronger association with PTSD than did any other outcome.

Table 2

*Means for Nine Outcome Variables by Deployment Status*

| Outcome | Short Cycle | Long Cycle | Not Again | Not Before | Never |
|---|---|---|---|---|---|
| Mental health | | | | | |
| Posttraumatic stress | 1.04[a] | 0.86[ab] | 1.04[a] | 0.70[c] | 0.72[bc] |
| Depression | 2.57[ab] | 2.39[bc] | 2.69[a] | 2.43[c] | 2.35[c] |
| Substances | | | | | |
| Alcohol problems | 1.16[a] | 0.97[ab] | 1.20[a] | 0.71[c] | 0.71[bc] |
| Heavy drinking | 1.84[a] | 1.35[bc] | 1.60[ab] | 1.26[d] | 1.21[cd] |
| Tempted drug use | 0.20[a] | 0.11[ab] | 0.19[a] | 0.13[b] | 0.08[b] |
| Actual drug use | 0.06[a] | 0.02[abc] | 0.05[ab] | 0.02[c] | 0.01[bc] |
| Tobacco use | 8.45[a] | 6.23[ab] | 6.76[abc] | 5.40[c] | 5.19[bc] |
| Physical pain | | | | | |
| Pain level | 2.45[a] | 2.29[a] | 2.50[a] | 2.20[b] | 2.42[ab] |
| Pain sources | 2.26[a] | 2.00[a] | 2.22[a] | 1.82[b] | 1.69[b] |
| Group *n* | 235 | 577 | 269 | 639 | 140 |

*Note.* The superscript letters within each row of the table indicate homogeneous subsets of means compared across deployment groups.

Table 3

*Correlations of Outcome Variables With Deployment Cycle Timing Variables*

| Outcome | Total Past Deployments | Length of Last Deployment | Months Since Last Return | Time Until Next Departure |
|---|---|---|---|---|
| Mental health | | | | |
| Posttraumatic stress | .03 | .06 | -.07* | -.09*** |
| Depression | -.02 | .04 | -.08** | -.07** |
| Substances | | | | |
| Alcohol problems | -.04 | .03 | -.08* | -.08** |
| Heavy drinking | -.04 | -.01 | -.13*** | -.13*** |
| Tempted drug use | -.06 | .03 | -.09** | -.12*** |
| Actual drug use | -.04 | .05 | -.04 | -.05 |
| Tobacco use | .01 | -.03 | -.03 | -.09*** |
| Physical pain | | | | |
| Pain level | .05 | .00 | .02 | -.09*** |
| Pain sources | -.01 | .04 | -.04 | -.08** |

*Note.* Participants with a deployment history, $N$ = 1,079–1,081; participants expecting future deployment, $N$ = 1,451.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 3 presents bivariate correlations between each outcome and 4 different deployment cycle variables (total number of past deployments, duration of last deployment, months since last return, and time until next departure). For months since return and especially for time until departure, outcomes tended to be negatively related to time. That is, symptom levels tended to be lower as time since last return increased, and to be higher as time until future deployment decreased. Again, these relationships were small, particularly for time since return. Correlations

were even weaker for number of deployments and duration of last deployment, and were not significant for these variables.

In Appendix 1, Figures A through D graphically illustrate the bivariate relationships among our outcome variables and deployment cycle timing. We plotted symptom levels in relation to time since last deployment and time until future deployment as reported by participants on the date on which they participated in the survey. We graphed these relationships separately by deployment group (Figure A, short cycle; Figure B, long cycle; Figure C, no future deployment; Figure D, no prior deployment). For the purposes of graphing, we had to exclude participants with extremely short (<6 months, $n$ = 25) or long (>24 months, $n$ = 153) deployment interims because they could not be plotted within the x-axis timeline categories used in Figures A and B. A visual inspection of these graphs suggests that there may be important differences in patterns of symptom change over time across deployment cycle groups. Therefore, all subsequent hypothesis tests included deployment cycle group as a potential moderator.

*Hypothesis 1*

According to our first research hypothesis, among combat veterans, symptom levels of PTSD, depression, and substance abuse should follow parallel courses across the deployment cycle. In order to evaluate this, we first conducted a series of hierarchical regression analyses for each outcome to model the best functional form representing changes in symptom patterns over time. Because this hypothesis focused on combat veterans ($n$ = 1,081), personnel who had never previously deployed were excluded. In each case, demographic control variables (sex, age, service, rank, education) were entered in Block 1. In Block 2, total combat exposure, number of past deployments, and duration of last deployment were entered. Missing data in these 2 blocks of variables were replaced with the sample mean. Block 3 included 2 dummy variables

representing deployment cycle group (<1 year between deployments; not redeploying), with the long deployment cycle group serving as the comparison. Blocks 4, 5, and 6 examined the effects of deployment cycle timing in terms of months since return from last deployment at the time participants completed the survey. The linear, quadratic, and cubic terms for months since return were each entered on sequential steps. Finally, 2-way interactions between the deployment cycle group dummy variables (from Block 3) and both time since return (Block 5) and duration of last deployment (Block 6) entered in the last 2 blocks.[2]

Table 4 summarizes significant results from this series of hierarchical regressions. Appendix 2, Table B lists standardized regression coefficients for the effects of each deployment-related predictor on each outcome. Effects are rank-ordered from strongest positive to weakest (or from weakest to strongest negative for inverse associations). In addition, Table B provides the results of direct comparison of the relative strength of the coefficients across outcomes. As can be seen in Table 4, rank was the demographic characteristic most consistently related to outcomes. Higher rank was associated with significantly lower symptom levels for all outcomes but alcohol problems (i.e., API). Furthermore, the API had a significantly attenuated relationship with rank by comparison with all other outcomes except heavy drinking and tobacco use (see Appendix 2, Table B). Older age and being female were protective factors for substance use in some instances. Considering service branch, affiliation with the U.S. Navy was a protective factor, at least for heavy drinking and pain sources. Surprisingly, higher increasing education was a risk factor for temptation to use drugs and total numbers of pain sources.

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[2]Although we originally considered interactions between the nonlinear quadratic and cubic terms for deployment timing with deployment cycle group, issues with multicollinearity (tolerances <.10) made it infeasible to test these higher order effects.

However, this was the case only while controlling for other demographics; bivariate correlations between education and these 2 outcomes were negative and not statistically significant.

Not surprisingly, combat exposure was a significant risk factor for all outcomes (see Table 4). However, it was a significantly stronger predictor of PTSD symptoms than of any other outcome including depression, despite the high comorbidity between these 2 types of mental health symptoms (see Appendix 2, Table B). Combat was also a stronger risk factor for the number of pain sources than it was for any other outcome except PTSD. It was weakest in relation to substances, particularly illegal drug use.

The remaining deployment history variables had only a few significant effects. Total numbers of prior deployments were not a significant predictor of any outcome (see Table 4). However, due to opposing trends in the direction of the effect of this factor, there were some significant differences in its effects across outcomes (see Appendix 2, Table B). After controlling demographics and other combat characteristics, duration of last deployment was somewhat protective in relation to tobacco use. It was unrelated to this outcome based on bivariate correlation. Also, significant deployment cycle group differences were observed for 2 outcomes. First, compared with those with longer deployment interims, personnel with short deployment cycles reported more heavy drinking. This effect was moderated by an interaction with deployment duration, indicating that a short interim was primarily a risk for heavy drinking among personnel deployed for longer periods of time. Second, personnel who expected no future deployment exhibited higher levels of depression than personnel between deployments with at least a year at home. Depression was a significantly stronger risk factor for this deployment cycle group than 6 out of 8 outcomes considered, including PTSD (see Appendix 2, Table B).

Table 4

*Significant Results (beta coefficients) of Hierarchical Regression Analyses Predicting Outcomes by Time Since Last Deployment*

| | PTSD | Depression | Alcohol dependence | Heavy drinking | Tempted drug use | Actual drug use | Tobacco use | Pain level | Pain sources |
|---|---|---|---|---|---|---|---|---|---|
| Block 1 | | | | | | | | | |
| Sex | | | | ***0.12*** | | | 0.07 | | |
| Age | | | *-0.12* | *-0.14* | | | | | |
| Service | | | | *-0.09* | | | | | -0.06 |
| Rank | **-0.17** | ***-0.18*** | | -0.11 | ***-0.18*** | **-0.16** | *-0.12* | ***-0.19*** | ***-0.20*** |
| Education | | | | | 0.08 | | | | *0.10* |
| Block 2 | | | | | | | | | |
| Combat exposure | ***0.37*** | ***0.20*** | ***0.19*** | ***0.17*** | ***0.12*** | ***0.11*** | ***0.15*** | ***0.21*** | ***0.27*** |
| No. deployments | | | | | | | | | |
| Time deployed | | | | | | | -0.06 | | |
| Block 3 | | | | | | | | | |
| < 1 yr cycle | | | | *0.08* | | | | | |
| Final deployment | | ***0.11*** | | | | | | | |

Table 4 Continued…

| | PTSD | Depression | Alcohol dependence | Heavy drinking | Tempted drug use | Actual drug use | Tobacco use | Pain level | Pain sources |
|---|---|---|---|---|---|---|---|---|---|
| Block 4 | | | | | | | | | |
| Time back | | | | -.07 | | | | .07 | |
| Months squared | | | -.07 | | | | | | |
| Months cubed | | | | | | | | | |
| Block 5 | | | | | | | | | |
| <1 yr × time back | | | | | | | | | |
| Final × time back | | | | | | | | | |
| Block 6 | | | | | | | | | |
| <1 yr × time dep. | | | | *0.09* | | | | | |
| Final × time dep. | | | | | | | | | |

*Note.* Analyses included only participants who were combat veterans, $n$ = 1,081. In Block 4 linear and nonlinear terms for time since return entered individually; in all other blocks, variables entered simultaneously. Coefficients are provided for the step in which each variable entered the model. Only betas significant at $p < .05$ are listed in the table; higher levels of significance are indicated with italics and bolding ($p < .05$; $p < .01$; $\mathbf{p < .001}$). PTSD = Posttraumatic Stress Disorder.

Contrary to our hypothesis, after controlling for other factors, time since return from deployment was generally not predictive of outcomes. The linear effect was significant in only two instances, for heavy drinking and pain sources. In the first case, heavy drinking prevalence dropped with time since return, and significantly more so by comparison with all other outcomes (see Appendix 2, Table B); in the second, pain levels actually tended to increase over time. Finally, we found one significant nonlinear (quadratic) relationship with alcohol problems (API; $p < .05$). This effect indicated that symptoms rose slightly among participants for approximately a year and half post return (15.73 months) before declining again. Interestingly, the magnitude of this quadratic effect was significantly larger by comparison with the quadratic effect estimates for pain level, tobacco use and even heavy drinking (see Appendix 2, Table B).

*Hypothesis 2*

Hypothesis 2 predicted that symptom levels would be highest 4–6 months after returning from deployment. To test this hypothesis, we conducted a 3 (time home group) × 3 (deployment cycle group) MANCOVA on the nine outcome variables. Time home groups were created by classifying returning veterans based on how long ago they had returned from their last deployment (0–3 months; 4–6 months; or 7 or more months). Again, because this hypotheses concerned only veterans ($n$ = 1,081), personnel who had not previously deployed were excluded; this left 3 deployment cycle groups (short cycle, long cycle, and never again). As in all analyses, demographic controls (sex, age, service, rank, education) were entered as covariates. Multivariate $F$ tests revealed no significant main effect of time home; contrary to Hypothesis 2, these results suggest that the symptom levels of veterans who had been home for 4–6 months did not significantly differ from those of veterans who had been home for a shorter or longer time.

Likewise, neither the multivariate main effect of deployment cycle group nor the multivariate interaction effect was statistically significant.

*Hypothesis 3*

Hypothesis 3 predicted that as a future combat deployment approached, both veterans and nonveterans would demonstrate linear increases in mental and physical health symptoms. This was assessed by conducting a series of multiple regression analyses similar to the set conducted to test Hypothesis 1. Because this hypothesis concerned only those who expected to deploy in the future ($n$ = 1,451), returning veterans who did not expect to redeploy were excluded. In these analyses, demographic controls were again entered in Block 1. In Block 2, dummy variables representing deployment cycle group were entered (first-time deployers; short interim [<1 year]), with combat veterans reporting a relatively long interim (≥1 year) between deployments as the comparison group. Deployment-history variables could not be included here because not all participants included in the analysis had previously deployed. In Block 3, linear, quadratic, and cubic terms for time until next deployment were entered sequentially.

Table 5 in this section and Table C in Appendix 2 present the results of these analyses. The demographic results observed across the 9 outcomes were generally similar to those obtained previously (cf. Table 4). However, higher rank was not as consistent a protective factor for this subsample of participants (those expecting to deploy in the future) as in the previously analyzed subsample (those who had deployed in the past). In the current analysis, the effect of rank was particularly attenuated in relation to alcohol problems and binging, significantly so by comparison with temptation to use drugs, depression, pain level, and pain sources (see Appendix 2, Table C). We also found a number of significant differences in symptom levels by deployment cycle group. Having a shorter amount of time between deployments (vs. a longer interim) was

related to increased substance use, including heavy drinking, temptation to use drugs, and drug use. In addition, personnel who had not previously deployed reported lower levels of all negative outcomes than did combat veterans between deployments (see Table 5).

As expected, relationships between outcomes and time until future deployment were primarily linear. This main effect was significant for PTSD, alcohol dependence, heavy drinking, temptation to use drugs, pain level, and pain sources. In each case, as time to departure grew shorter, symptoms increased (see Table 5). The only significant differences in the relative strength of the effects of an approaching deployment on outcomes were all in relation to illegal drug use. Effects for illegal drug use were significantly weaker by comparison with the temptation to use drugs, as well as heavy drinking and pain level (see Appendix 2, Table C). Unexpectedly, we found one significant quadratic effect between expected time to departure and PTSD. The positive coefficient indicated a concave shape, with symptoms initially decreasing and then increasing again, with the inflection at approximately 9–10 months predeployment. There were no other significant nonlinear effects in any of our models.

Table 5

*Significant Results (beta coefficients) of Hierarchical Regression Analyses Predicting Outcomes by Time Until Next Deployment*

| | PTSD | Depression | Alcohol dependence | Heavy drinking | Tempted drug use | Actual drug use | Tobacco use | Pain level | Pain sources |
|---|---|---|---|---|---|---|---|---|---|
| Block 1 | | | | | | | | | |
| Sex | | | *0.07* | ***0.13*** | | | 0.06 | | 0.06 |
| Age | | | | *-0.10* | -0.08 | | | | |
| Service | | | | ***-0.09*** | | | | | -0.06 |
| Rank | | *-0.13* | | | -0.10 | | | *-0.11* | *-0.11* |
| Education | | | 0.07 | | | | | | |
| Block 2 | | | | | | | | | |
| <1 yr cycle | | | | *0.09* | 0.06 | *0.08* | | | |
| First deployment | ***-0.20*** | -0.07 | ***-0.17*** | ***-0.14*** | -0.07 | -0.08 | ***-0.13*** | ***-0.12*** | ***-0.15*** |
| Block 3 | | | | | | | | | |
| Time to departure | -0.07 | | -0.06 | -0.07 | ***-0.10*** | | | *-0.08* | -0.06 |
| Time squared | 0.06 | | | | | | | | |
| Time cubed | | | | | | | | | |

*Note.* Analyses included only participants expecting a future deployment, $n$ = 1,451. Variables within Blocks 1 and 2 entered simultaneously; terms were entered individually in Block 3. Only statistically significant betas ($p < .05$) are listed in the table; higher levels of significance are indicated with italics and bolding ($p < .05$; $p < .01$; $\mathbf{p < .001}$). PTSD = Postraumatic Stress Disorder.

*Hypothesis 4*

Hypothesis 4 suggested that in response to the stress of preparing for deployment, combat veterans would be less likely than first-time deployers to report increases in psychological symptoms and more likely to report such changes in behavioral or physical symptoms. Therefore, we expected to find stronger relationships between time until next deployment and PTSD, depression, and alcohol dependence for first-time deployers than for combat veterans. Conversely, we expected all other outcomes (behavioral reports of substance use, as well as pain level and pain sources) to be more weakly predicted by time until future deployment for first-time deployers than for repeat deployers. To test this hypothesis, first, we modified the regression analysis described above to include interactions between deployment cycle group and time until future deployment on the final step of the analysis. Contrary to our hypothesis, the interaction of time until next deployment and veteran status was not significant in any equation.[3] Instead, veterans had higher levels of symptoms than nonveterans across the board.

We further considered differences in the strengths of the effect of first-time deployment status across outcomes. The protective effect for this group was greatest for PTSD and weakest for depression and substance use (see Appendix 2, Table C). There also were some differences in the effects of a short versus long deployment cycle interim across outcomes. Interestingly, a short deployment cycle was most strongly a risk factor for heavy drinking and most weakly a risk factor for alcohol problems.

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[3]Outcomes were the same whether we included separate dummy variables to compare all 3 deployment groups in this analysis (first deployment, short cycle, long cycle [comparison]) or a single dichotomous variable comparing first-time deployers with all other participants preparing to deploy.

The fact that time until next deployment was predictive of most outcomes even after controlling other factors is noteworthy, particularly given that our parallel analyses of effects of time since return for Hypothesis 1 yielded so few significant effects. However, this divergent predictive utility could be due to differences in the samples included in the 2 analyses (excluding nonveterans vs. excluding those never redeploying), or to the inclusion of previous deployment experience variables as controls in the regressions evaluating Hypothesis 1. To compare the effects of time away and time back on the same set of respondents, we conducted an additional set of regression analyses that included only participants between deployments (i.e., personnel who had deployed in the past and expected to deploy again, $n = 812$). After controlling for demographics, we entered the standardized transformed variables for both time since return and time until departure. Main effects for time until next deployment were significant predictors of all but 2 outcomes (drug and tobacco use), whereas time since return was significantly related only to heavy drinking. The absolute value of the effect of time until next departure was greater in every case, which would be highly unlikely if the population effect sizes were equal ($p < .001$).

Finally, to further illuminate the relative stress of returning home versus preparing for another deployment, we conducted a series of mean comparisons. Still considering only personnel who were in between deployments, we compared symptom levels for those within 3 months of return versus those within 3 months of departure. (Those who had both returned within the last 3 months and expected to depart within 3 months were excluded.) We found that symptom levels were consistently higher among those preparing to leave. For 4 outcomes (PTSD, API, temptation to use drugs, pain sources), these differences were significant ($p < .05$) even after controlling for demographic differences. Interestingly, when we further examined

groups of persons who were 4–6 months out, 7–9 months out, or 10–12 months out from return versus departure, 89% of mean symptoms were worse for those returning than for those departing. However, again controlling for demographics, only one difference (heavy drinking at 10–12 months) reached significance. Furthermore, compared with these other groups overall, symptom levels averaged across our 9 outcomes were at their apex among persons within 0–3 months of departure.

## Discussion

The purpose of this study was to describe patterns across time in comorbid symptoms of posttraumatic stress, depression, and substance use with respect to the deployment cycle. The goal was to assess whether different types of symptoms show similar trajectories and to determine periods of peak symptomology in the context of rotating deployments. The survey data included groups of participants at all points within the deployment cycle, including (1) personnel preparing to deploy for the first time, (2) personnel between deployments with varying lengths of time in the interim, (3) persons returning home from deployment for the last time, and (4) persons who were not deploying at all.

Initial results showed that the overall well-being of these groups differed, even after controlling for demographic differences among them. Those deploying for the first time or not deploying at all reported the best adjustment across 9 different psychological and behavioral indicators. Veterans preparing to redeploy after less than a year home and those returning home with no expectation of redeployment reported the poorest overall adjustment. It should be noted that group differences were fairly small. Group membership accounted for only 1% (illegal drug use) to 4% (PTSD) of the variance in symptom levels across outcomes.

Hierarchical multivariate regression results suggested that the negative effects associated with a shorter versus a longer (1 year or more interim) deployment cycle may be limited to outcomes related to substance use, particularly heavy drinking. The finding that personnel with a short deployment cycle are particularly at risk for heavy episodic drinking might be a reaction to the prohibition against alcohol use in the theater. That is, perhaps personnel drink more directly before or after deployment in an attempt to compensate for the time they have not been or will not be able to drink. Of course, increases in drinking may also constitute an attempt to deal with stress, which may be greater among those with shorter deployment cycles.

The results of our analyses assessing specific hypotheses lent more definition to the picture of when and how veterans may be vulnerable across the deployment cycle. Hypothesis 1 suggested that combat veterans' levels of PTSD, depression, and substance abuse would follow parallel courses across the deployment cycle. With respect to this hypothesis, we found some evidence for small but systematic patterns of change in symptoms over time, with greater effects in relation to the approach of an impending deployment than for readjustment upon returning home. Specifically in the case of time since return from last deployment, we found little evidence for a consistent pattern of symptom development. Although bivariate correlations generally revealed small linear decreases in symptoms levels over time after returning from deployment, using multivariate regression this pattern was only significant for heavy drinking. Furthermore, the magnitude of the negative linear effect for heavy drinking was significantly stronger in comparison with all other outcomes. In contrast, we found the opposite relationship (symptoms increasing slightly over time) for overall physical pain levels.

In Hypothesis 2, we had predicted nonlinear effects in relation to time since return from deployment, with symptoms increasing through 4–6 months postdeployment and decreasing

thereafter. We did find a small nonlinear effect for alcohol problems/addiction, suggesting that symptoms levels may increase following deployment before later decreasing; however, peak levels were estimated to occur at 15–16 months postdeployment. This does not fit the expected pattern. Further, when we directly compared participants who had been back from deployment for 4–6 months with those who had been back for a shorter or longer time, we found no significant differences. It is possible that the predicted effects were obscured due to biases inherent in retrospective reporting. For example, if levels of current symptomatology influence reports of the nature and severity of combat exposure, estimates of the association between these 2 variables will be inflated; controlling for combat exposure may artificially remove relevant variance from other associations. These issues cannot be teased apart without prospective/longitudinal research.

Our third hypothesis of a linear increase in symptom levels as a pending deployment approached was generally confirmed. Bivariate correlation revealed that this relationship was significant for all outcomes but illegal drug use, where extremely low prevalence rates make it difficult to obtain statistically significant effects. In multivariate analyses with demographic controls, the approach of a pending deployment was still uniquely predictive of most outcomes. Although we had not expected this, for combat veterans it appeared that the approach of a future deployment was a more reliable predictor of overall adjustment than was length of time since return from last deployment. It is possible that stressors, intervening variables, and ensuing symptom levels are more complex following deployment than they are in the face of a pending deployment. If returning veterans present a mixture of delayed onset, gradual improvement, and within-person variability in symptomatology over time, it may be harder to find any significant postdeployment timing effects for the group as a whole.

Our last hypothesis suggested that either defense mechanisms or fears regarding the consequences of acknowledging psychological difficulties might make combat veterans, in comparison with first-time-deploying personnel, less likely to acknowledge deteriorating psychological symptoms (e.g., PTSD, depression, substance dependence) than physical or behavioral symptoms (e.g., pain level, excessive substance use). If this were the case, veteran status should affect the strength of the correlations between these outcomes and time until next deployment. We did not find any evidence for moderated increases in problems or symptoms with the approach of a future deployment for combat veterans versus first-time deployers. Combat veterans were at greater risk for all outcomes in comparison with nondeployers regardless of deployment cycle timing. However, combat veterans were at significantly greater comparative risk in relation to PTSD, alcohol problems/addiction, and pain sources, than for depression or both tempted and actual drug use.

It is not surprising that combat veterans would experience greater symptoms of PTSD overall than first-time deployers. Furthermore, it is likely that Marine Corps deterrents against illegal drug use keep this problem at very low levels among all personnel, regardless of extenuating stressors. Further support for this possibility is the fact that the approach of a future deployment was a significantly stronger risk factor for the temptation to use illegal drugs than for actual drug use. Although stress may increase the desire to use, policy deterrents appear sufficient to prevent the vast majority from taking action on this desire. Alternatively, this finding might reflect the fact that personnel simply are less willing to report illegal drug use than the temptation to use on a self-report survey, even one that promises anonymity. It is likely that both Marine Corps policy and self-report bias play a role in explaining these results.

The present results may also shed light on the impact of Marine Corps policies and social culture on alcohol use. As noted earlier, for example, uniquely high levels of heavy drinking among personnel with a short interim between deployment cycles could be a rebound effect related to prohibitions against alcohol during deployment. This seems more likely given the fact that patterns of change in heavy drinking levels over time following deployment were significantly different from patterns for alcohol dependence. Trends in binging were significantly more linearly decreasing and less quadratic; again, this suggests the possibility of rebound effects in reaction to prohibitions in theater may taper off more simply and directly than is the case for more entrenched alcohol dependency issues.

The use of alcohol to cope with or prepare for deployment also appears to be somewhat culturally normative. The best evidence of this in our data was the fact that rank effects were weakest for alcohol problems—and, in relation to time to departure, also heavy drinking—of all the outcomes examined. This suggests that alcohol use, either as a coping resource or as a means of celebrating before or after deployment, uniquely pervades service culture. This also indicates that public health programs targeting excessive alcohol use might be more effective with a foundational component focusing on leadership and encouraging role modeling of responsibility drinking from the top down.

Comparing binging and alcohol problems with PTSD symptoms, we found significant differences in symptom patterns in relation to both time since last return from deployment (binging only) and time until future departure. Again, this may be because military policies and social norms play a role in shaping substance use independently of the influence of operational stress. Also, recent studies of PTSD comorbidity suggest that substance use may not be as strong of a risk factor for PTSD as PTSD is for substance use. For instance, a recent longitudinal study

did not find that alcohol problems were a significant risk factor for the emergence of new incidents of PTSD following combat exposure (LeardMann, Smith, Smith, Wells, & Ryan, 2009). On the other hand, victims of trauma may not be at risk for substance use disorders in the absence of PTSD (N. Breslau, Davis, & Schultz, 2003).

*Strengths and Limitations*

There are a number of challenges inherent in studying combat stress reactions among veterans. First, only correlational research is possible, since a random experimental design would be infeasible and unethical. Second, the importance of the confidentiality of data regarding sensitive subjects (e.g., illegal drug use, suicidal ideation) explored in the NHRC Combat Stress and Substance Use survey made it necessary to use a completely anonymous study design. This, along with difficult logistics of repeatedly surveying over time, made it impossible for us to use a longitudinal study design. In exploring symptom development and causal interrelationships among different behavioral and psychological health characteristics, both experimental and longitudinal methods are optimal. As a result, the primary weakness of this study is its reliance on self-reports of retrospective events and experiences. Additionally, of all the deployment-timing variables examined in this study, we found the strongest and most reliable relationships with outcomes for expected time until next deployment. In retrospect, we wish that we had assessed this variable with greater precision, rather than asking it on a 5-point scale for ease of response. Finer detail would likely have further increased the statistical power of this variable.

On the other side of the coin, this study has some important strengths. It offers the advantage of exploring, in-depth, the combat deployment histories and deployment timing of Marine Corps veterans in relation to data regarding potentially sensitive psychobehavioral outcomes. We also had information about personnel in all different phases of the deployment

cycle, facilitating fine-grained comparisons that would not be possible in a longitudinal study with snapshots of a single cohort at only 2 or 3 specified points in time. This study is further unique in looking at different components of deployment-cycle timing in conjunction with one another. Especially for veterans who are between deployments, our results suggest that the relative timing of the next deployment is important. In fact, among veterans in rotating deployments, we observed the highest overall symptom levels among personnel within 3 months of redeployment. Finally, we were able to evaluate our hypotheses with respect to multiple measures of each of our primary outcomes of interest (mental health, substance use, physical health).

## Conclusions

We found only weak systematic patterns of symptom change over time in relation to the deployment cycle, with time until future deployment having a greater impact on adjustment than time since return from last deployment. We found no evidence that peak symptoms of PTSD or any other specific outcome either precedes or follows another in time. It is likely that longitudinal research could better identify developmental precedence, and it would be more efficient in identifying and tracking patterns of symptom change across time. Methodologies that have the flexibility to assess symptoms at frequent intervals would be most helpful, rather than the typical longitudinal design, which takes snapshots at two or three distinct points in time. After a more comprehensive baseline survey, the use of new technologies such as text messaging, e-mail, or Twitter to follow up with simple queries of 1 or 2 questions on a monthly or weekly basis could be effective in this regard (Uriell, Clewis, & Rosenfeld, 2010).

This study suggests some fruitful directions for prevention efforts. First of all, it identifies some at-risk groups. Personnel with a short deployment interim are one population that could be

targeted, particularly with substance abuse prevention efforts. Another target group would be combat veterans who are not redeploying. In this category, it could be important to explore population subgroups. For instance, some personnel who are more symptomatic may be choosing to leave the service or they may be changing occupational specialties in order to avoid redeployment. Resolving unidentified or under-identified mental or physical health issues in this group could be a retention issue. This group would also include persons who process out because their mental or physical health problems make it necessary; these personnel are hopefully already receiving support services. However, identifying and resolving comorbid mental health issues would still be important. Finally, more attention could be focused on the stress experienced by combat veterans imminently preparing to redeploy, since mental health symptomology may be higher among this group than among those who have just returned home.

# References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders (DSM-IV)* (4th ed.). Washington, DC: Author.

Arbuckle, J. L. (2006). Amos (Rel. 7.0.2) [Software]. Crawfordvill, FL: Amos Development Corporation.

Barrett, D. H., Carney Doebbeling, C., Schwartz, D. A., Voelker, M. D., Falter, K. H., Woolson, R. F., et al. (2002). Posttraumatic stress disorder and self-reported physical health status among U.S. military personnel serving during the Gulf War period. *Psychosomatics, 43,* 195-205.

Basoglu, M., Kilic, C., Salcioglu, E., & Livanou, M. (2004). Prevalence of posttraumatic stress disorder and comorbid depression in earthquake survivors in Turkey: An epidemiological study. *Journal of Traumatic Stress, 17,* 133-141.

Bliese, P. D., Wright, K. M., Adler, A. B., Thomas, J. L., & Hoge, C. W. (2007). Timing of postcombat mental health assessments. *Psychological Services, 4,* 141-148.

Boman, B. (1986). Combat stress, posttraumatic stress disorder, and associated psychiatric disturbance. *Psychosomatics, 27,* 567-573.

Boscarino, J. A. (1995). Post-traumatic stress and associated disorders among Vietnam veterans: The significance of combat exposure and social support. *Journal of Traumatic Stress, 8,* 317-336.

Branchey, L., Davis, W., & Lieber, C. S. (1985). Alcoholism in Vietnam and Korea veterans: A long-term follow-up. *Alcoholism: Clinical and Experimental Research, 8,* 572-575.

Breslau, J. (2004). Cultures of trauma: Anthropological views of posttraumatic stress disorder in international health. *Culture, Medicine and Psychiatry, 28,* 113-126.

Breslau, N. (2002). Epidemiologic studies of trauma, posttraumatic stress disorder, and other psychiatric disorders. *Canadian Journal of Psychiatry, 47*, 923-929.

Breslau, N., Davis, G. C., Peterson, E. L., & Schultz, L. (1997). Psychiatric Sequelae of posttraumatic stress disorder in women. *Archives of General Psychiatry, 54*, 81-87.

Breslau, N., Davis, G. C., & Schultz, L. R. (2003). Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Archives of General Psychiatry, 60*, 289-294.

Brown, R. L., Leonard, T., Saunders, L. A., & Papasouliotis, O. (2001). A two-item conjoint screen for alcohol and other drug problems. *Journal of the American Board of Family Practice, 14*, 95-106.

Cherpitel, C. J. (2000). A brief screening instrument for problem drinking in the emergency room: The RAPS4. *Journal of Studies on Alcohol, 61*, 447-449.

Chesbrough, K. B., Ryan, M. A. K., Amoroso, P., Boyko, E. J., Gackstetter, G. D., Hooper, T. I., et al. (2002). The Millennium Cohort Sutdy: A 21-year prospective cohort study of 140,000 military personnel. *Military Medicine, 164*, 483-488.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Erlbaum.

Cohen, P., Brook, J. S., Cohen, J., Velez, C. N., & Garcia, M. (1990). Common and uncommon pathways to adolescent psychopathology and problem behavior. In L. Robins & M. Rutter (Eds.), *Straight and devious pathways from childhood to adulthood* (pp. 242-258). Cambridge, MA: Cambridge University Press.

Federman, E. B., Bray, R. M., & Kroutil, L. A. (2000). Relationships between substance use and recent deployments among women and men in the military. *Military Psychology, 12*, 205-220.

Ferrada-Noli, M., Asberg, M., & Ormstad, K. (1998). Suicidal behavior after severe trauma. Part 2: The association between methods of torture and of suicidal ideation in posttraumatic stress disorder. *Journal of Traumatic Stress, 11*, 113-124.

Green, B. L., Grace, M. C., Lindy, J. D., Gleser, G. C., & Leonard, A. (1990). Risk factors for PTSD and other diagnoses in a general sample of Vietnam veterans. *American Journal of Psychiatry, 147*, 729-733.

Grieger, T. A., Cozza, S. J., Ursano, R. J., Hoge, C., Martinez, P. E., Engel, C. C., et al. (2006). Posttraumatic stress disorder and depression in battle-injured soldiers. *American Journal of Psychiatry, 163*, 1777-1783.

Grieger, T. A., Fullerton, C. S., Ursano, R. J., & Reeves, J. J. (2003). Acute stress disorder, alcohol use, and perception of safety among hospital staff after the sniper attacks. *Psychiatric Services, 54*, 1383-1387.

Hoge, C. W., Auchterlonie, J. L., & Milliken, C. S. (2006). Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *Journal of the American Medical Association, 295*, 1023-1032.

Hoge, C. W., Castro, C. A., Messer, S. C., McGurk, D., Cotting, D. I., & Koffman, R. L. (2004). Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *New England Journal of Medicine, 351*, 13-22.

Howell, D. C. (1992). *Statistical Methods for Psychology* (3rd ed.). Belmont, CA: Duxbury Press.

Keane, T. M., Fairbank, J. A., Caddell, J. M., Zimering, R. T., Taylor, K. L., & Mora, C. A. (1989). Clinical evaluation of a measure to assess combat exposure. *Psychological Assessment, 1*, 53-55.

Keane, T. M., Gerardi, R. J., Lyons, J. A., & Wolfe, J. (1988). The interrelationship of substance abuse and posttraumatic stress disorder: Epidemiological and clinical considerations. *Recent Developments in Alcohol Research, 6*, 27-48.

Killgore, W. D. S., Stetz, M. C., Castro, C. A., & Hoge, C. W. (2006). The effects of prior combat experience on the expression of somatic and affective symptoms in deploying soldiers. *Journal of Psychosomatic Research, 60*, 379-385.

Kilpatrick, D. G., Ruggiero, K. J., Acierno, R., Saunders, B. E., Resnick, H. S., & Best, C. L. (2003). Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: Results from the National Survey of Adolescents. *Journal of Consulting and Clinical Psychology, 71*, 692-700.

King, D. W., King, L. A., & Vogt, D. S. (2003). *Manual for the Deployment Risk and Resilience Inventory (DRRI): A collection of measures for studying deployment-related experiences of military veterans*. Boston, MA: National Center for PTSD.

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2003). The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Medical Care, 41*, 1284-1292.

LeardMann, C. A., Smith, T. C., Smith, B., Wells, T. S., & Ryan, M. A. K. (2009). Baseline self reported functional health and vulnerability to post-traumatic stress disorder after combat deployment: Prospective US military cohort study. *British Medical Journal, 338*, 1-9.

Maguen, S., Litz, B. T., Wang, J. L., & Cook, M. (2004). The stressors and demands of peacekeeping in Kosovo: Predictors of mental health response. *Military Medicine, 169*, 198-206.

Riddle, J. R., Smith, T. C., Smith, B., Corbeil, T. E., Engel, C. C., Wells, T. S., et al. (2007). Millennium Cohort: The 2001-2003 baseline prevalence of mental disorders in the U.S. military. *Journal of Clinical Epidemiology, 60*, 192-201.

Rona, R. J., Hooper, R., Jones, M., Hull, L., Browne, T., Horn, O., et al. (2006). Mental health screening in armed forces before the Iraq war and prevention of subsequent psychological morbidity: Follow-up study. *British Medical Journal, 333*, 1-5.

Ryan, M. A. K. (2007). *Millennium Cohort Study*. Retrieved June 6, 2007, from http://www.millenniumcohort.org/

Spitzer, R. L., Kroenke, K., & Williams, J. B. (1999). Validation and utility of a self-report version of the PRIME-MD: The PHQ Primary Care Study. *Journal of the American Medical Association, 282*, 1737-1744.

SPSS Inc. (2009). Predictive Analytics SoftWare (PASW) Statistics 17.0.3. Chicago, IL.

Stewart, S. H. (1996). Alcohol abuse in individuals exposed to trauma: A critical review. *Psychological Bulletin, 120*, 83-112.

Trent, L. K., Hilton, S. M., & Melcer, T. (2005). *Premilitary tobacco use by male Marine Corps recruits* (NHRC Tech. Rep. No. 05-29). San Diego, CA: Naval Health Research Center.

Uriell, Z., Clewis, E., & Rosenfeld, P. (2010, March). *Embracing non-traditional means of communications in the Navy.* Paper presented at the Positioning for the Future: Strategies for the Navy Total Force Enterprise, Key Bridge, Rosslyn, VA.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993, October). *The PTSD Checklist (PCL): Reliability validity, and diagnostic utility.* Paper presented at the Annual Meeting of the International Society for Traumatic Stress Studies, San Antonio, TX.

Whooley, M. A., Avins, A. L., Miranda, J., & Browner, W. S. (1997). Case-finding instruments for depression: Two questions are as good as many. *Journal of General Internal Medicine, 12,* 439-445.

Appendix 1

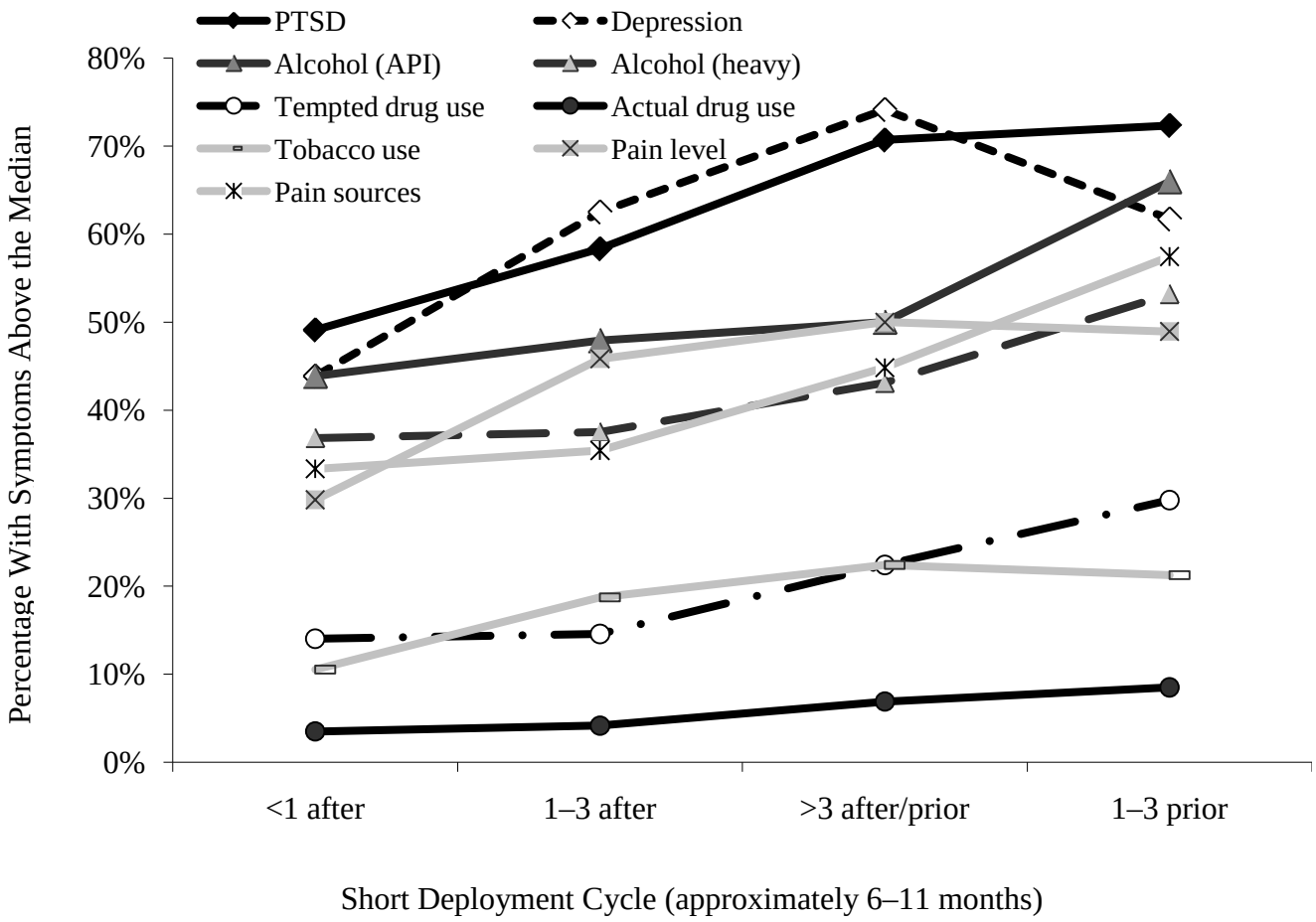


*Figure A.* Symptom levels by deployment cycle timing among persons reporting a short deployment cycle (approximately 6–11 months; $n$ = 210). Persons with <6 months between deployments were excluded. API = Alcohol Problem Index. PTSD = posttraumatic stress disorder.

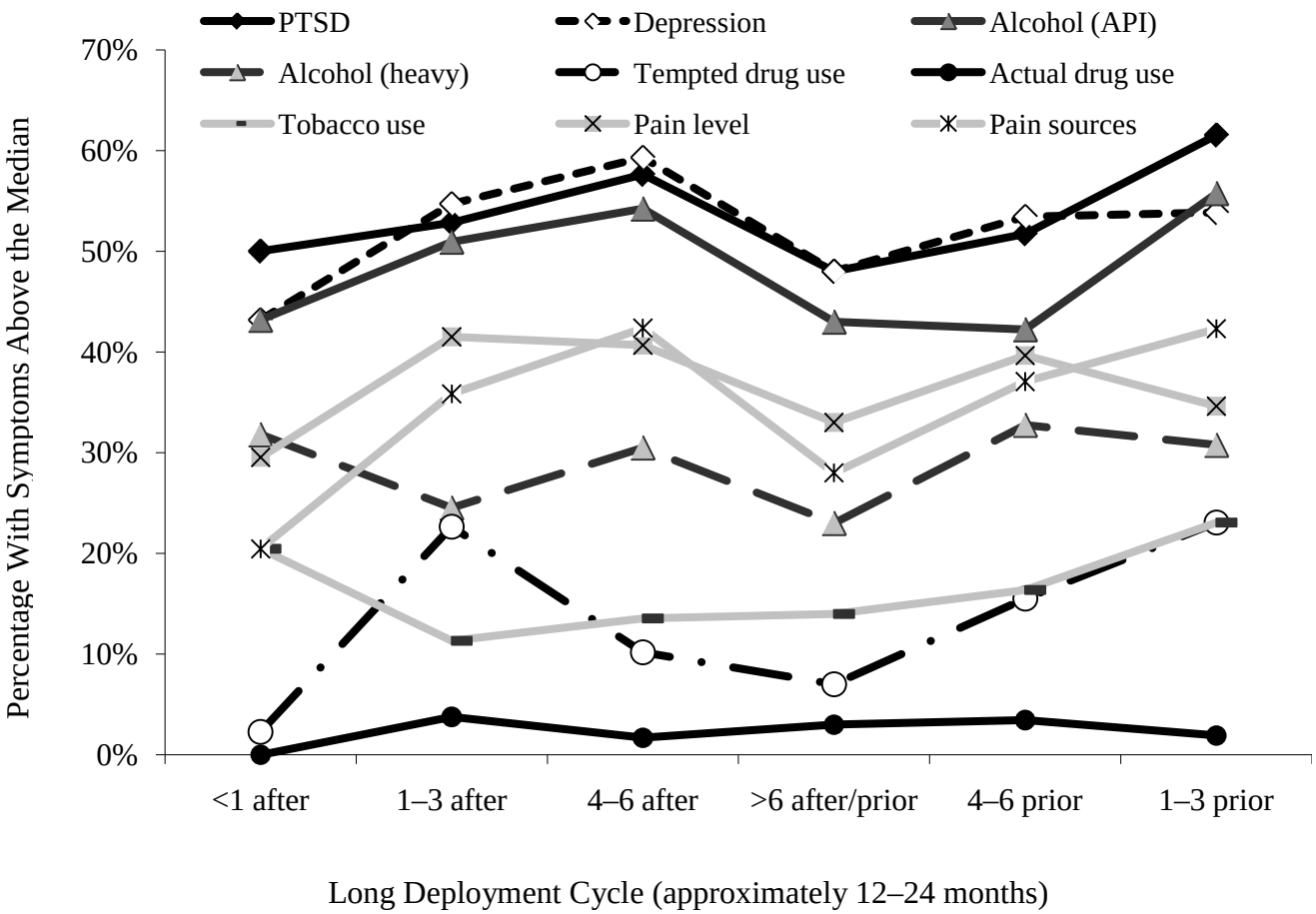


*Figure B.* Symptom levels by deployment cycle timing among persons reporting a long deployment cycle (approximately 12–24 months; *n* = 424). Persons with >24 months between deployments were excluded. API = Alcohol Problem Index. PTSD = posttraumatic stress disorder.

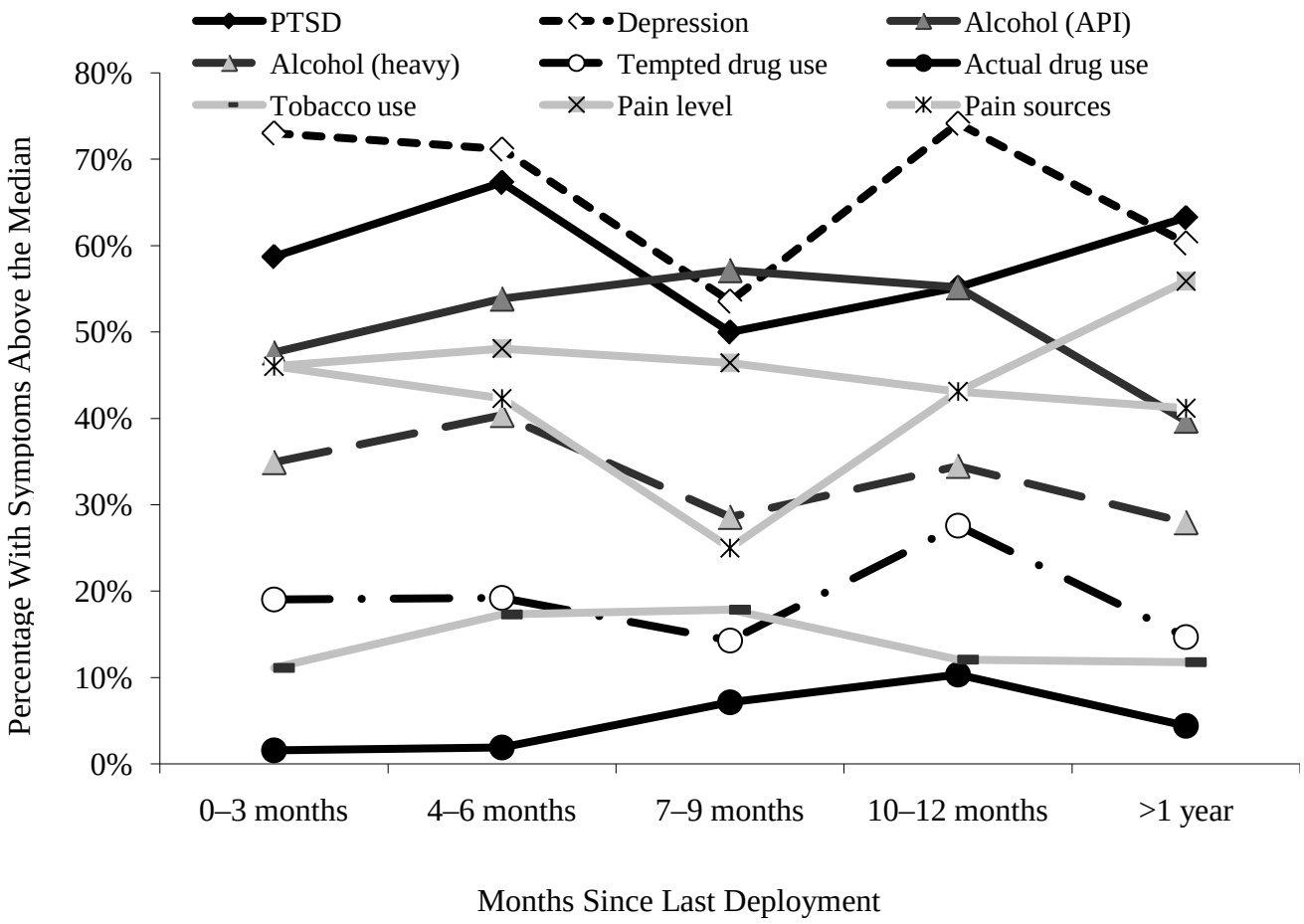


*Figure C.* Symptom Levels by time since last deployment among persons expecting no future deployment (*n* = 269). API = Alcohol Problem Index. PTSD = posttraumatic stress disorder.

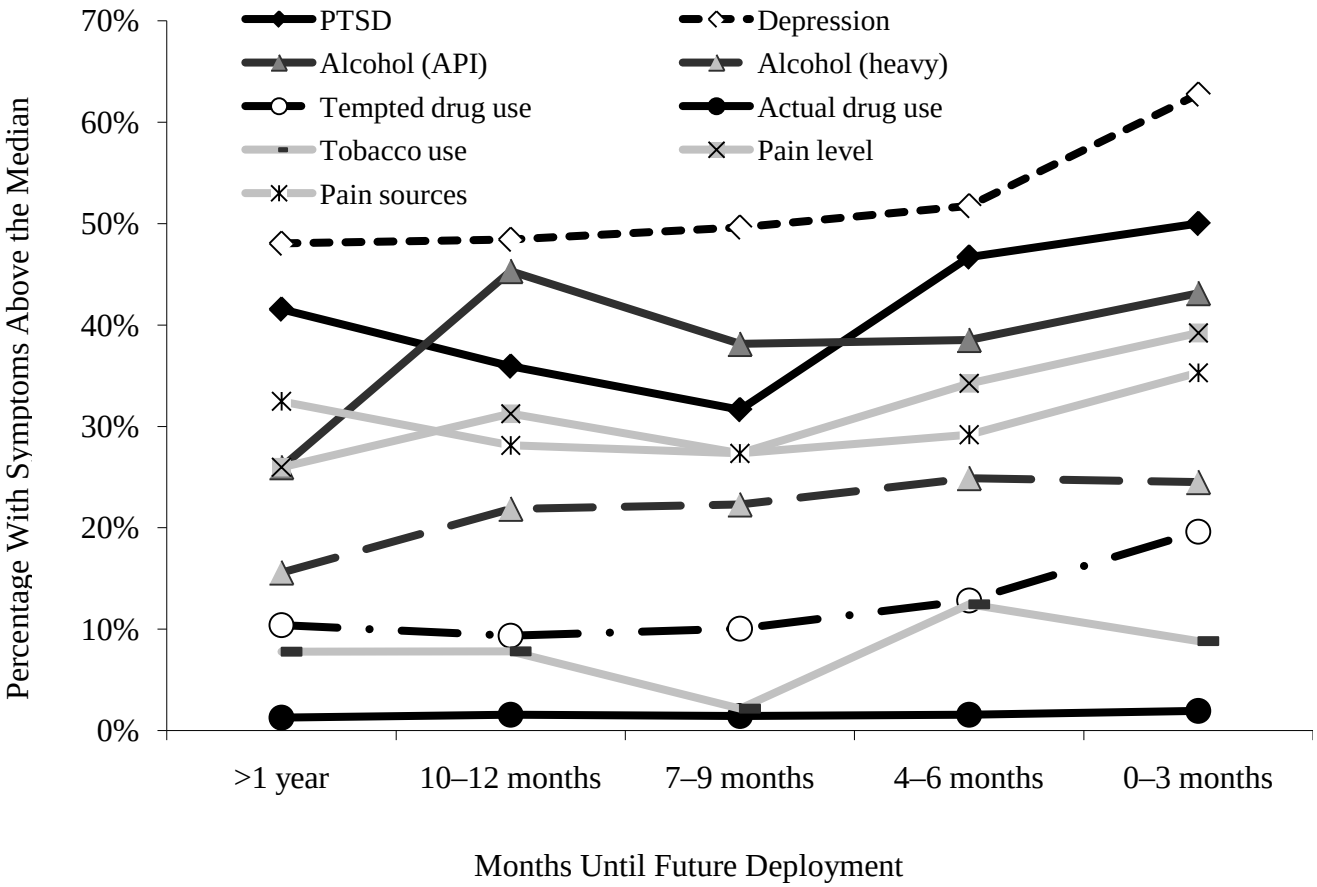


*Figure D.* Symptom levels by time until future deployment among persons with no previous deployment ($n$ = 639). API = Alcohol Problem Index. PTSD = posttraumatic stress disorder.

Appendix 2

Table A

*Significant*[†] *Correlations Among Study Outcome Variables for Combat Veterans (below the diagonal) and Nonveterans (above)*

| | PCL[‡] | DSS | API | HD | TDU | ADU | TU | PPL | PPT |
|---|---|---|---|---|---|---|---|---|---|
| PCL[‡] | — | .75[a] | .25[c] | .11[de] | .20[cd] | | .11[de] | .41[b] | .39[b] |
| DSS | .76[a] | — | .22 | .10 | .23 | | .09 | .38 | .38 |
| API | **.36**[c] | **.32** | — | .49 | .18 | .11 | .11 | .10 | .30 |
| BD | **.23**[de] | .18 | .54 | — | .21 | .09 | .26 | | .18 |
| TDU | .25[d] | .26 | **.32** | .25 | — | .30 | .12 | .17 | .14 |
| ADU | **.18**[e] | **.17** | **.20** | .17 | **.46** | — | | .08 | |
| TU | **.21**[de] | **.20** | .13 | .29 | .16 | **.23** | — | .11 | .13 |
| PPL | .43[c] | .35 | .16 | .13 | .16 | .07 | .16 | — | .51 |
| PPS | **.49**[b] | .43 | .36 | **.31** | **.26** | .15 | .18 | .49 | — |

*Note.* [†]Only correlations significant at least at the $p < .05$ level are listed in the table. All figures are partial correlations controlling for demographic variables (sex, age, service, rank, education). [‡]Within the first column/row, correlations with the same superscript letter do not differ in the strength of their association with PTSD. Bolding indicates significantly larger effects for combat veterans than for nonveterans, $p < .05$ (veterans, $n = 1{,}021$; nonveterans, $n = 728$); no correlations were significantly larger for nonveterans. PCL = PTSD Checklist. DSS = Depression Symptom Scale. API = Alcohol Problem Index. HD = heavy drinking. TDU = tempted illegal drug use. ADU = actual illegal drug use. TU = tobacco use. PPL = physical pain level. PPT = physical pain sources.

Table B

*Differences in Predictive Effects Across Outcomes in Regression Analyses of Hypothesis 1 (betas are in parentheses)*

| | Time Since Return | | | Other Deployment Effects | | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Linear† | Square† | Cubic | Combat | No. Deps. | Time Away | Short Cycle | Last Dep. |
| 1 | **PPL (0.07)$^{a}$** | PPL (0.05)$^{a}$ | DSS (0.09)$^{a}$ | **PTS (0.37)$^{a}$** | PPL (0.06)$^{a}$ | ADU (0.04)$^{a}$ | **HD (0.08)$^{a}$** | **DSS (0.11)$^{a}$** |
| 2 | PPS (0.05)$^{a}$ | TU (0.02)$^{ab}$ | API (0.09)$^{ab}$ | **PPS (0.27)$^{b}$** | TU (0.03)$^{ab}$ | TDU (0.02)$^{ab}$ | ADU (0.06)$^{ab}$ | TDU (0.05)$^{ab}$ |
| 3 | ADU (0.03)$^{a}$ | HD (0.01)$^{ab}$ | TDU (0.07)$^{ab}$ | **PPL (0.21)$^{c}$** | PCL (0.02)$^{abc}$ | DSS (0.02)$^{ab}$ | TDU (0.05)$^{ab}$ | PPL (0.05)$^{ab}$ |
| 4 | PCL (0.03)$^{a}$ | PCL (-0.02)$^{bc}$ | HD (0.06)$^{ab}$ | **DSS (0.20)$^{c}$** | DSS (0.01)$^{abc}$ | PCL (0.01)$^{ab}$ | DSS (0.05)$^{ab}$ | PTS (0.04)$^{b}$ |
| 5 | API (0.02)$^{a}$ | PPS (-0.03)$^{bc}$ | ADU (0.03)$^{ab}$ | **API (0.19)$^{c}$** | HD (0.01)$^{bcd}$ | PPS (0.01)$^{ab}$ | TU (0.04)$^{ab}$ | API (0.04)$^{bc}$ |
| 6 | TU (0.02)$^{a}$ | ADU (-0.03)$^{bc}$ | TU (0.02)$^{ab}$ | **HD (0.17)$^{cd}$** | TDU (0.00)$^{bcd}$ | API (0.00)$^{abc}$ | PTS (0.04)$^{ab}$ | ADU (0.03)$^{bc}$ |
| 7 | DSS (0.02)$^{a}$ | TDU (-0.04)$^{bc}$ | PTS (0.01)$^{ab}$ | **TU (0.15)$^{cd}$** | PPS (-0.01)$^{bcd}$ | PPL (-0.04)$^{bcd}$ | PPL (0.03)$^{ab}$ | HD (0.02)$^{bc}$ |
| 8 | TDU (0.01)$^{a}$ | DSS (-0.04)$^{bc}$ | PPS (0.00)a$^{b}$ | **TDU (0.12)$^{d}$** | API (-0.03)$^{cd}$ | HD (-0.05)$^{cd}$ | API (0.02)$^{ab}$ | PPS (0.01)$^{bc}$ |
| 9 | **HD (-0.07)$^{b}$** | **API (-0.07)$^{c}$** | PPL (-0.03)$^{b}$ | **ADU (0.11)$^{d}$** | ADU (-0.04)$^{d}$ | **TU (-0.06)$^{d}$** | PPS (0.02)$^{b}$ | TU (-0.02)$^{c}$ |

*Note.* Bolding indicates significant coefficients within the original regression models. Superscript letters indicate homogenous subsets of regression coefficients across models, $p < .05$. For each independent variable, beta values and corresponding dependent variables from each of the 9 regression models are ranked and listed from highest to lowest. †Indicates variables hypothesized to have a negative relationship with outcomes; negative betas ranked lowest have the strongest effects. PCL = PTSD Checklist. DSS = Depression Symptom Scale. API = Alcohol Problem Index. HD = heavy drinking. TDU = tempted illegal drug use. ADU = actual illegal drug use. TU = tobacco use. PPL = physical pain level. PPT = physical pain sources.

Table C

*Differences in Predictive Effects Across Outcomes in Regression Analyses of Hypotheses 3 and 4 (betas are in parentheses)*

| | Time Until Departure | | | | | | Other Deployment Effects | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Rank | Linear† | | Square | | Cubic | | Short Cycle | | First Deployment† | |
| 1 | ADU | (-0.02)[a] | **PTS** | **(0.06)[a]** | HD | (0.02)[a] | **HD** | **(0.09)[a]** | **DSS** | **(-0.07)[ab]** |
| 2 | DSS | (-0.05)[ab] | PPS | (0.04)[ab] | PTS | (0.01)[ab] | **ADU** | **(0.08)[ab]** | **TDU** | **(-0.07)[ab]** |
| 3 | TU | (-0.05)[ab] | TDU | (0.04)[ab] | TU | (0.01)[ab] | **TDU** | **(0.06)[ab]** | **ADU** | **(-0.08)[a]** |
| 4 | **PPS** | **(-0.06)[ab]** | PPL | (0.04)[ab] | DSS | (0.00)[ab] | DSS | (0.06)[ab] | **PPL** | **(-0.12)[abc]** |
| 5 | **API** | **(-0.06)[ab]** | TU | (0.03)[ab] | PPL | (-0.01)[ab] | PTS | (0.05)[ab] | **TU** | **(-0.13)[bcd]** |
| 6 | **PTS** | **(-0.07)[ab]** | ADU | (0.02)[ab] | ADU | (-0.05)[ab] | TU | (0.05)[ab] | **HD** | **(-0.14)[cd]** |
| 7 | **HD** | **(-0.07)[b]** | DSS | (0.01)[ab] | TDU | (-0.08)[ab] | PPL | (0.04)[b] | **PPS** | **(-0.15)[cd]** |
| 8 | **PPL** | **(-0.08)[b]** | API | (0.00)[b] | PPS | (-0.11)[ab] | PPS | (0.03)[b] | **API** | **(-0.17)[cd]** |
| 9 | **TDU** | **(-0.10)[b]** | HD | (-0.01)[b] | API | (-0.14)[b] | API | (0.03)[b] | **PTS** | **(-0.20)[d]** |

*Note.* Bolding indicates significant coefficients within the original regression models. Superscript letters indicate homogenous subsets of regression coefficients across models, $p < .05$. For each independent variable, beta values and corresponding dependent variables from each of the 9 regression models are ranked and listed from highest to lowest. †Indicates variables hypothesized to have a negative relationship with outcomes; negative betas ranked lowest have the strongest effects. PCL = PTSD Checklist. DSS = Depression Symptom Scale. API = Alcohol Problem Index. HD = heavy drinking. TDU = tempted illegal drug use. ADU = actual illegal drug use. TU = tobacco use. PPL = physical pain level. PPT = physical pain sources.

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This study explored adjustment among combat veterans in relation to the deployment cycle. In particular, it evaluated potential linear and nonlinear patterns in symptom levels in relation to both time since return home and time prior to future departure, and assessed the homogeneity of patterns of change over time across different outcomes. Personnel from U.S. Marine Corps units at three installations in Southern California completed an anonymous survey assessing a range of mental, behavioral, and physical health outcomes. Participants also were asked about their place within the deployment cycle. Results yielded scant evidence for nonlinear patterns of symptom development following deployment. Overall, time until next deployment was a stronger predictor of outcomes than was length of time since last deployment.

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deployment, combat veterans, posttraumatic stress, depression, substance use

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